# *Odor Control Test Report of the Urine Containment Bag (UCB) for Orion Utilization*

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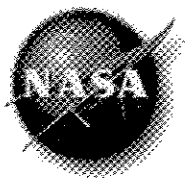


National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

# *Odor Control Test Plan of the Urine Containment Bag (UCB) for Orion Utilization*

## Signature Sheet

Prepared by:

Stephanie Casper — Date: 9/29/10

Nichole M. M. Williams — Date: 10/5/10

Approved by:

Bobbie Gail Swan — Date: 10/5/2010

Constellation Portable Equipment and Pyrotechnics, Manager

National Aeronautic and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas

# Change Record

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## APPLICABLE DOCUMENTS

The following documents, of the exact issue and revision shown, form a part of this specification to the extent specified herein.

| Document | Title/Citation |
|---|---|
| JSC-65891 | Odor Control Test Plan of the Urine Containment Bag (UCB) for Orion Utilization |
| WSTF #10-44500 | Cx Urine Containment Bag Testing, Special Test Data Sept 2010 |
| CxP 70024 | Constellation Program Human-Systems Integration Requirements |
| Anxiety Disorders Edition 16 (2002) | The relationship between disgust sensitivity and avoidant behavior: Studies of clinical and nonclinical samples |
| SentBlocker Product Data | ScentBlocker® Robinson Outdoors Products, Robinson Outdoors Products, n.d. Web. 31 Aug. 2010. |
| Expert Report of Donald Thompson, PhD | Thompson, Donald, Ph.D. "Expert Report of Donald Thompson, Ph.D." *ScentLok*. ALS Enterprises, Inc. 7 Aug. 2006. Web. 31 Aug. 2010. |

# Purpose

The purpose of this report is to summarize the conclusions for the odor control test of the Urine Containment Bag (UCB), P/N SDD46107234-306 in an environment simulating a space craft capsule. JSC 65891, *Odor Control Test Plan of the Urine Containment Bag (UCB) for Orion Utilization*, documents the test plan. The details of the test set-up and data reduction are detailed in the WSTF test report for this test WSTF #10-44500, *Odor Control Test Plan of the Urine Containment Bag (UCB) for Orion Utilization*,. This document outlines the project conclusions and forward plans with regard to trash containment for Constellation.

# 1.0 Test Conclusions

Based on the results outlined in WSTF #10-44500, there are several conclusions based on the usage of this bag for an Orion Block 0 mission.

First, for the first ~30 hours of the test, the total hydrocarbon content found in the filled UCB chamber atmosphere compared very closely to the measurements found in the chamber atmosphere of the empty bag. This implies that for this time period, the odor from the filled bag was similar to the odor of the empty bag. The total hydrocarbon content measured was due to the filled UCB off-gassing, not the odor from the trash. So, for a short duration mission, or if trash is off-loaded to ISS after docking, the Urine Containment Bag is a very acceptable option for containment of trash odor.

Second, once the odor from the filled UCB started to permeate through the UCB into the chamber volume, it continued to permeate throughout the remainder of the two week test. The slope of the increase is dependent upon temperature. In WSTF #10-44500, Figure 13, it is clear that when the temperature is lowered from 85 °F to 75 °F, the slope of the total hydrocarbon content measured decreases. Therefore, the time of acceptability for the trash odor is directly dependent upon the temperature at which the trash is stowed.

Third, the human odor panel test results showed an increase in the offensiveness of the odor from the filled UCB over the duration of the test. In addition, the after effects (bad taste in mouth, headaches, nausea) increased over the test duration. In WSTF #10-4450, Tables 6-9, the after effects of each panel member are noted. Therefore, if trash is to remain on the Orion vehicle for two weeks, there may be negative effects on the crew.

Finally, the Urine Containment Bag clearly held some odor, since the slope drastically increased upon opening the bag at the end of the test (Figure 13, WSTF #10-4450). Therefore, a bag such as the UCB is significantly better than trash stowed without a containment bag.

In addition to the conclusions above, there are several conservative aspects of this test that should be highlighted:

1. Since the trash is present at the start of the test, it implies that the trash is generated at the time of launch. The trash used in this odor test (food wrappers, filled diapers, and filled emesis bags) will take a certain amount of time to generate and accumulate.
2. The volume of emesis, urine, feces, and food trash is very conservative considering two crew members.
3. It is possible that improvements will be made to the temperature profile for Orion, so using the extreme high temperature of 85 °F was very conservative.
4. Limited air circulating in the vehicle and in the suit were not taken into consideration and could improve the local odor at the crew position.
5. The odor test did not solely test the Urine Containment Bag as a method of containment for trash. It tested the effectiveness of the MAG and Ziploc Bag for containing the urine and feces, and the Emesis Bag and Ziploc Bag for containing emesis. It also tested the effectiveness of the ISS Waste Bag to contain trash and Emesis Bags. If any of those primary methods of containment failed during the two-week test duration, then the UCB became the primary method of containment.

# 2.0 Feasibility of Alternative Options

The final conclusions of the two-week odor test for the Urine Containment Bag (UCB) P/N SDD 46107234-306 revealed that the UCB contained odors for approximately 30 hours. The odor panel members could detect a smell for the filled UCB at 48 hours. The range of smell (taking the average ranking of each member over the 9 samples) at 48 hours was from 0.89 to 2.44 on a scale of -4 to 4 (-4 = extremely pleasant, 4 = extremely irritating/revolting). The goal of the project team was for the UCB to contain the odors for at least the 48 hours. Still trying to work towards this goal, the project team has continued to research possibilities which could improve upon the design of the UCB or replace it completely.

Option 1: Carbon Spray

The first option would be to coat the outside of the UCB with a carbon spray. The carbon spray would have the least affect on the design of the Urine Containment Bag. Two examples of carbon sprays are the White Lightning Spray and Evolve3 Field Spray. The sprays, if applied evenly to the outside of the bag, would allow carbon molecules (or carbon-like molecules) to adhere to the surface of the Nomex material of the UCB. These molecules work to "eliminate scent by odor adsorption and chemical neutralization" (ScentBlocker® Robinson Outdoors Products). The Evolve3 Field Spray is promoted as using enzymes for odor control and bacterial control (bacteria contributes to the odor).

The drawback to using these sprays is that a person cannot know if the spray is evenly coated onto the white Nomex surface without significantly soaking the material (only then would the darker shade be seen). These sprays have a tendency when applied in heavy volume to "flake" off the material, which could lead to safety issues. Most carbon or carbon-like sprays are highly flammable so if "flaking" occurs, this introduces a new hazard of free-floating flammable particles.

Option 2: Carbon Liner

The second option that could be used to improve upon the design of the Urine Containment Bag is the integration of a carbon web or liner. A carbon liner could be placed or sewn in along the inside of the UCB. One example of a carbon liner is the ScenTote Carbon Web Adsorber Replacement. The activated carbon within the liner relies primarily "on the physical sorption of gases into the unique, accessible internal pore structure. Larger molecules can readily penetrate the macropores and mesopores. As the chemicals pass into the structure and reach finer pores, the surface attractions increase greatly. The sorbed material can move into the structure until it reaches a pore size with excellent surface attraction that will trap the odor chemical in place" (Thompson, 16-17). This prevents the molecules of the odor chemical from traveling through the carbon liner to reach the outside air.

The drawback to a carbon liner is that it must be secured in some manner so the liner remains along the inside walls of the bag even when the bag is in different orientations. The design of the UCB would have to be altered to accommodate the carbon liner, which would lead to longer manufacturing time. However, this option only alters the inside and does not compromise the Nomex outer layer. The UCB would remain non-flammable.

Option 3: New Bag

Another option to try to better contain the odors would be to replace the Urine Containment Bag, and certify a new bag. Two options for hunting bags that are designed to control odors are the Scent-Lok Rugged Duffle Bag and the ScenTote Storage Bag. Both these bags are similar in volume to the current Urine Containment Bag. The Scent-Lok Rugged Duffle Bag is made of a poly-cotton blend with the carbon incorporated into the poly-cotton. The ScenTote Storage Bag is made from canvas. On the top opening/flap of the canvas bag, there is a pocket that holds the Carbon Web Adsorber. The ScenTote does not have a carbon liner for the entire inside of the bag.

The drawback to this option is the bags are COTS hardware, and would have to be certified for flight. Both these bags are flammable so appropriate safety precautions would have to be followed.

# 3.0 Conclusions

Due to funding reductions, this work will be shelved until direction and funding dictate a forward path. The data from this test shows that the Urine Containment Bag is a feasible option (as is) for short duration missions with a

certain expectation of odor penetration and undesirable side effects. For a long duration mission, the UCB alone will not be an acceptable odor containment method. A more complex bag with filtering or a vented vehicle will be required to contain odors for longer periods of time.